5. On new Species and Varieties of the Land-Molluscan Genus *Diplommatina* from the Garo, Naga, and Munipur Hill-ranges, Assam.

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The arrival of a large collection of Land-Shells sent me by Mr. T. H. Aldrich, of Cincinnati, U.S.A., and made by Mr. W. Doherty in 1889 in different parts of the Naga Hills and Munipur, has led me to take up and work out those belonging to the genus *Diplommatina*; for I had also in my own collection a number of undescribed species of the same genus which I had found when surveying that country in 1872. I had also specimens collected by the late Mr. Chennell in the Lhota Naga Hills and by Mr. Robert in Munipur and the Garo Hills, making up a fine series for examination. Mr. Doherty made Kohimah in the Naga Hills his headquarters, and was there during the summer months; he also collected in the Eastern Naga Hills, south of Margarita, which is the terminus of the Railway from Debrughur to the coal-workings and about 50 miles distant. In this neighbourhood he was, being in quite unexplored ground, very successful as regards novelties, while at the same time he extended the range of other species. Mr. Doherty collected the minute specimens himself, while his men were looking after Lepidoptera and Coleoptera; some of the larger shells were brought to him by the Nagas, but he could not get them to search for the small forms.

Although I was in the Naga Hills in the winter and spring only, the driest time of the year, I got a fine series of the Land-Shells; the season does not make much difference on the high peaks, which are so often covered with cloud for a part of the day, and the sun does not penetrate into the damp northern ravines. I trained several men of my party to collect, both Khasis and Ghoorkhas, and they became most expert in finding the minute forms in the decaying vegetation, and four annas for every new species or for a good number of specimens was quite sufficient as an inducement to work hard. I found them very keen of sight, and they very soon knew the different genera and those I most wanted. Mr. Doherty was far too liberal in giving the Nagas two rupees for shells. In the forests and noisome jungly ravines, at times swarming with leeches, this work is not over pleasant, and it is only the interest and excitement of finding some beautiful new form at any moment that leads one on this lowly chase, as it has me for many an hour. To the native collector it is far less exciting, and he credits his master with making some wonderful curative out of the animals.

In 1875 I published descriptions of three new species of this genus in the J. A. S. B.; and under *D. tumida*, var., I then referred to the great differences to be noticed in the shells from different parts of the Burrail range, and urged that a careful examination should be made of them all. I have now been able to better

this, aided by the additional material sent me by Mr. Aldrich, to whom my very sincere thanks are due and also to Mr. Doherty who collected them. This gentleman has extended the area of country now collected in much farther to the east, up to Margarita, as I mentioned before; and these Naga Hills, inhabited by the most Eastern representatives of this race, must not be confounded with the Naga Hills inhabited by the Anghamis, which are 150 miles to the westward. Thus one box containing a number of only partly sorted tubes sent me by Mr. Aldrich had simply Naga Hills attached to it. As Mr. Doherty's letter, also enclosed, was dated from Kohima in the Anghami Naga Hills, I naturally at first concluded they were from that part. Fortunately, I afterwards found series of the same species in tubes in another box, marked "Margarita." It shows how very carefully labelling should be done in the field.

Looking over a large series of the species of this genus, it is of interest to note the much larger size of so many of the species from the Naga Hill-ranges, as compared with those in the Khasi and Garo Hills and the Himalayas. The change commences with the rise of the Burrail Tertiary range, near Asalu. None of the Khasi Hill species approach them in size.

D. scalaria, from the Garo side, is one of the largest, and that is only 3·5 millim. in height of spire; while *D. pachycheilus*, 4·8, or say 5 millim., is the single large species from Darjiling. At Asalu we find *D. insignis* 6·5 millim., *D. tumida* 5 millim., *D. convoluta* 6·25 millim., and, as will be seen in the new forms described in this paper, six are 5 millim. in height and over, two of them reaching 6 millim.

Of *D. janitiaca*, G.-A., one example was sent from Margarita.

Constriction in front, above the peristome; sculptured throughout.

DIPLOMMATINA DECOROSA, n. sp.

Loc. Anghami, Naga Hills (*W. Doherty*, in coll. T. H. Aldrich).

Shell elongately fusiform, not rimate; sculpture, fine, close, regular costulation on all the whorls; colour pale whitish horny; spire, sides somewhat flat, apex rather acuminate, rapidly diminishing; suture moderately impressed; whorls 8, sides flatly convex, penultimate and antepenultimate equal; constriction above the aperture, towards the outer margin; aperture ovate, rounded below; peristome thickened; columellar tooth small, in front.

Size: maj. diam. 2·5; alt. axis 5·5 millim.

There was one solitary specimen in my collection of this species from north of the Burrail, and 6 specimens, but smaller in size (4·5 millim. in height of spire), from the peak of Shiroifurar, in the Lahupa Naga Hills, north of Munipur. Mr. Aldrich's collection contains a large number, and I have selected the type out of these.

On the boss of trap rock near the village of Phunggam I found a number of a small variety, 4·5 millim. in height of spire, but differing in no respect, except in size, from the typical species, only that they are all of a pale sea-green tint.

The same form occurred on Kopamedza Peak, with this difference,

that the constriction was more to the right, directly over the outer margin of the peristome. From Prowi, specimens were still smaller in size, 3·8 millim.

Constriction in front, above the peristome; last whorls smooth.

DIPLOMMATINA GAROENSIS, n. sp.

Loc. Garo Hills; exact locality unknown (*W. Robert*).

Shell dextral, globosely fusiform, solid; sculpture, distant, very fine ribbing on the 3 apical whorls, the rest smooth and shiny; colour pale ochraceous; spire high, side very convex; apex acuminate, and when viewed from the side the axis is curved; suture impressed; whorls $6\frac{1}{2}$, all tumid, the antepenultimate much swollen and by far the largest; constriction above the aperture; aperture vertical, oval; peristome very much thickened and double; columellar tooth moderately large.

Size: maj. diam. 2·3; alt. axis 3·5 millim.

This species may be known by its very large antepenultimate whorl and the curved axis of the spire, and its strongly developed peristome and smooth lower whorls. It formed part of a collection of shells made by Mr. W. Robert, of the Khasi Hills Survey party, in the Garo Hills, during the military expedition into them in 1872–73. Ten specimens were found.

DIPLOMMATINA ELONGATA, n. sp.

The typical shells of my *D. tumida* (J. A. S. B. xxxix. pt. 2, p. 6, pl. ii. f. 2) came from Neuglo in the North Cachar Hills, not far from Asalu. As I collected eastward the form changed, so that in Munipur it does not correspond with the original type. Thus on Nougmaiching Peak, 5135 ft., which is a conspicuous point seen from Imphal, the capital of Munipur, and lying to the east of the valley, a small form occurred, with the peristome less circular, the form less tumid, and quite smooth on the last whorls.

On Laisen Peak, 5173 ft., in the mountains to the north of Munipur, occurred another variety, which I describe below.

At Kezakenomih I found examples of a species which I described and figured in 1875 (J. A. S. B. vol. xliv. pt. 2, pl. iv. fig. 7) as *D. tumida*, var. This, however, seems so very distinct, now that we have a much larger series to look over, that it must stand under another specific title, and I have named it D. ELONGATA, n. sp.: this was the original description:—

"Shell elongately fusiform, thin, pale yellowish green; sculpture very faint above, quite smooth on the three last whorls; spire attenuate, sides flat; suture moderate; whorls $8\frac{1}{2}$ to 9, the antepenultimate the largest; constriction in front above the aperture; last whorl ascends slightly; aperture oval, vertical; peristome double, thickened, slightly reflected; columellar tooth small and remote. Alt. 0·22; diam. 0·13 inch.

"*Hab.* Kézákenomih, Naga Hills."

DIPLOMMATINA TUMIDA, var.

Loc. Laisen Peak and Trigonometrical Station, Munipur.

Shell dextral, elongately fusiform, not rimate; sculpture, fine costulation on the 5 apical whorls, the last smooth ; colour pale greenish ; spire with convex sides, apex acuminate; suture well impressed ; whorls $7\frac{1}{2}$, penultimate and antepenultimate equal ; constriction above the aperture, but towards the right-hand side; aperture oval, vertical; peristome thickened, double ; columellar margin straight and angulate below, the tooth in front, moderately large.

Size: maj. diam. 2·4 ; alt. axis 5·0 millim.

DIPLOMMATINA CHENNELLI, n. sp.

Loc. Lhota Naga Hills (*Chennell*).

Shell dextral, of solid form ; sculpture, very fine, rather distinct ribbing, with scarcely any relief; colour pale ochraceous and sienna-brown; spire flat-sided, apex acuminate; suture rather shallow ; whorls $8\frac{1}{2}$ to 9, sides flatly convex, constriction in front, the last two whorls equal in size ; aperture oval, vertical ; peristome thickened, strong ; the columellar margin vertical and angulate below.

Size: (1st sp.) maj. diam. 2·9 ; alt. axis 5·9 millim.

Size: (2nd sp.) maj. diam. 2·9 ; alt. axis 5·0 millim.

This has close affinities to *D. labiosa* from the Khasi and Garo Hills; but, although far larger (nearly double), the columellar tooth is much smaller, the spire more attenuate, and the general shape differs. I name it after the late Mr. A. Chennell, an Assistant in the Indian Survey Department.

DIPLOMMATINA BUTLERI, n. sp.

Loc. Laisen Peak, Munipur (*Godwin-Austen*).

Shell dextral, tumidly fusiform ; sculpture, none on the last 3 whorls, very distant, strong costulation on all above ; colour pale sienna-brown, fresh shells glassy and polished ; spire conic, rapidly diminishing, apex small ; suture well impressed ; whorls $7\frac{1}{2}$, penultimate and antepenultimate about equal, sides very convex, constriction above the aperture ; aperture nearly circular, vertical ; peristome double, strong, continuous ; columellar margin vertical, angulate below, the tooth large, in front.

Size: maj. diam. 2·0 ; alt. axis 4·4 millim.

Six specimens were obtained, together with those of *D. tumida*, var., previously alluded to. This well-marked species was also found by me at Prowi, in the Lahupa Naga Hills, at the head of the Lanier River, which drains into the Kyengdwen of Burmah, and was abundant there. I have also two specimens from Kezakenomih.

Two specimens from Klang Sing, Naga Hills, are rather more tumid.

I name this after Capt. John Butler, who was the Political Agent accompanying the Survey party on our exploring work, and who unfortunately lost his life in an ambuscade laid by a hostile clan, when the Survey work was again being prosecuted further east under

Lt. Woodthorpe, R.E. Butler was a splendid officer for such a frontier, and the Survey owed much to his untiring aid and to the interest he took in its proper extension.

DIPLOMMATINA AMBIGUA, n. sp.

Loc. South of Burrail Range, Munipur (*Godwin-Austen*).

Shell dextral, large, solid; sculpture fine, rather close costulation on all the whorls; colour horny white; spire high, sides rather flat above, apex rather acuminate; suture impressed; whorls 8, flatly convex; constriction in front, above the aperture; aperture oval, vertical; peristome strong, closely double, reflected; columellar tooth small for size of the shell, situated well in front and directed downwards.

Size: maj. diam. 3·0; alt. axis 5·5 millim.

This is one of the largest species from these mountains. I also got it at Kezakenomih; one specimen measuring 6·5 millim. in height of spire.

DIPLOMMATINA COMMUTATA, n. sp.

Loc. Prowi, Lahupa Naga Hills (*Godwin-Austen*).

Shell dextral, elongately fusiform; sculpture, 4 apical whorls finely costulated, the last whorls nearly smooth; colour pale sienna; spire with convex sides; suture moderately impressed; whorls $7\frac{1}{2}$, sides convex, antepenultimate rather the largest; constriction in front, above the aperture, but to the right side; aperture oval, vertical; peristome double; columellar tooth sharp, well developed, directed downwards and well in front.

Size: maj. diam. 1·75; alt. axis 3·0 millim.

A large form of this I found at Tellizo Peak, Anghami Naga Hills, on the North Munipur frontier line.

Constriction on side, behind the peristome; sculptured throughout.

DIPLOMMATINA DOHERTYI, n. sp.

Loc. Margarita, Upper Assam (*W. Doherty*, in coll. T. H. Aldrich).

Shell dextral, very tumidly fusiform, strong, not rimate; sculpture fine rather distant costulation on all the whorls; colour very pale, with a pinkish tint or ochraceous; spire, sides flat, rapidly diminishing, apex acuminate; suture impressed; whorls 8, last 3 whorls with convex sides, the penultimate the largest; constriction on side, well behind the aperture; the last whorl rises near peristome; aperture nearly circular, subvertical, rounded below; peristome double, outer somewhat reflected, and sinuous on margin; columellar tooth small, blunt, situated within the aperture, in many specimens it is not seen when viewed directly in front.

Size: maj. diam. 3·0; alt. axis 6·4 millim.

This shell is from the Eastern Naga country; there were two lots in Mr. Doherty's collection—one with a few specimens labelled "Margarita," another, a numerous lot, marked only "Naga."

DIPLOMMATINA THOMSONI, n. sp.

Loc. South Burrail (*Godwin-Austen*).

Shell dextral, elongately fusiform; sculpture, 3 apical whorls smooth, all the rest with very fine regular, rather close ribbing; colour whitish; spire rather high, sides flattened; apex rather blunt; suture moderately impressed; whorls $7\frac{1}{2}$, sides convex, the antepenultimate the largest, last whorl ascending near the aperture; constriction lies directly behind and adjacent to the peristome; aperture oval; columellar tooth small for size of shell and lying within the aperture; peristome as usual.

Size: maj. diam. 2·4; alt. axis 5·0 millim.

I have named this species after Col. Mowbray Thomson, who, at the time it was collected, accompanied our camp in his capacity of Political Agent of Munipur, while the boundary of that State was being surveyed by me in 1872–73; in carrying out this work he rendered us great assistance, although much thwarted by the unfriendly action of the Munipur Durbar.

In general form this shell is like *D. pachycheilus*, Bs., a Darjiling species, but the columellar tooth is never so large as in that species.

DIPLOMMATINA NENGLOENSIS, n. sp.

Loc. Nenglo, North Cachar Hills (*Godwin-Austen*).

Shell dextral, elongately fusiform, large, solid; sculpture very fine, moderately distant ribbing; colour pale ochraceous; spire high, with flat sides, apex acuminate; suture shallow; whorls $8\frac{1}{2}$, sides flatly convex; constriction some distance behind the aperture, on side; aperture widely ovate, expanded towards the outer margin; peristome double, not thickened; columellar margin subvertical, the tooth very small and remotely situated.

Size: maj. diam. 2·9; alt. axis 5·0 millim.

This is a very distinct shell; in its very ovate aperture and small columellar process or tooth it is unlike any other I have in my collection.

DIPLOMMATINA DISTINCTA, n. sp.

Loc. North of Burrail Range, Naga Hills (*Godwin-Austen*).

Shell dextral, small, rather depressedly fusiform; sculpture very fine close ribbing; colour pale horny; spire conoid; apex blunt; suture impressed; whorls 7, sides convex, the antepenultimate the largest; constriction on the side, well behind the aperture; aperture vertical, irregularly ovate; peristome thin; columellar tooth very large for size and in front.

Size: maj. diam. 2·0; alt. axis 3·4 millim.

There is only one specimen of this species, but it is very different from any of the smaller forms in having the constriction behind the aperture, and, for so small a shell, in having the columellar tooth so large.

Constriction on the side, behind the peristome; last whorls smooth.

DIPLOMMATINA KHUNHOENSIS, n. sp.

Loc. Khunho Peak and Trigonometrical Station, 8809 ft. above the Mao villages, Naga Hills (*in coll. H. H. G.-A.*).

Shell dextral, ovately fusiform, not rimate; sculpture, fine regular costulation on the 3rd, 4th, and 5th whorls, the 2 apical smooth, the last whorls polished and glassy; colour pale sienna; spire, side flattened near the apex, which is somewhat acuminate; suture impressed; whorls 8, the antepenultimate the largest; constriction behind the aperture on the penultimate whorl; aperture oval and vertical; peristome double, strong, continuous; columellar tooth well developed, rather remote.

Size: maj. diam. 2·2; alt. axis 4·8 to 5·2 millim.

Six specimens were found.

A form rather longer and less swollen occurs in the same range; about 30 specimens were obtained at Gnameh Peak (5585 feet), near the Barak River.

There is another form much smaller, being only 3·5 in length, with the same glassy last whorls and the constriction rather further back, behind the aperture. Examples of this were also found at Sikhamih, in the Lahupa Naga Hills. I distinguish this variety as *khunhooensis*, var. *minor*.

DIPLOMMATINA LAPILLUS, n. sp.

Loc. Kopamedza Peak, Lahupa Naga Hills, 8375 ft. (*Godw.-Aust.*).

Shell dextral, elongately fusiform, tumid below, not rimate; sculpture fine, regular, close costulation, which is often much worn down; colour (bleached); spire with sides flattened, apex acuminate; suture shallow; whorls 8, sides flatly convex, the antepenultimate the largest; constriction of the penultimate whorl on the side, well behind the aperture; aperture oval, subvertical; peristome thickened, double, rounded below; columellar tooth small and far back within the aperture.

Size: maj. diam. 3·0; alt. axis 6·0 millim.

Three specimens, marked from the "north of the Burrail Range." Two are from the typical locality given above.

DIPLOMMATINA COMPACTA, n. sp.

Loc. South of Barak in Munipur (*Godwin-Austen*).

Shell dextral, small, tumidly fusiform; sculpture, the two apical whorls smooth, two next with fine close ribbing, the last three whorls smooth or glassy; colour pale ochraceous white; spire, sides rather flat, apex moderately blunt; suture slightly impressed; whorls $7\frac{1}{2}$, the antepenultimate the largest and tumid; constriction on the side, well behind the aperture, at about 1 millim. distant; aperture oval, vertical; peristome double; columellar tooth large in front, and directed downwards.

Size: maj. diam. 1·8; alt. axis 3·5 millim.

A larger shell, with rather a different shaped spire 4 millim. in height, was found at Asalu, with the constriction in same position.

It is an allied form of *D. jatingana*, from the North Cachar Hills, which is a larger, more tumid species with the constriction farther behind the aperture.

A single specimen, only 3 millim. in height, was sorted out of the box containing *D. chennelli*, from the Lhota Naga Hills.

Small species, with columellar process.

Diplommatina unicrenata, n. sp.

Loc. Eastern Naga Hills (*W. Doherty*, in coll. T. H. Aldrich).

Shell dextral, ovately fusiform, subrimate, rather thin; sculpture, distant strong costulation on all the whorls; colour white, with a pale lemon-yellow tint in fresh shells; spire with sides convex, apex somewhat blunt; suture well impressed; whorls 7½, antepenultimate the largest, sides convex, the constriction above the aperture, in front; aperture circular, vertical; peristome double, outer wavy in outline, with one very marked and decided crenulation on the upper outer margin, and a slight sinuation on the left lower margin; columellar tooth large and directed downwards.

Size: alt. axis 4·0 millim.

A very large number of this new shell are in Mr. Doherty's collection, four from Margarita in a tube, the remainder marked as from the Naga Hills. This is a very beautiful new species, the only shell approaching it that I know from this region being *D. angulata* of Moulmain.

Diplommatina japvoensis, n. sp.

Loc. Japvo Peak, Anghami Naga Hills, 10,000 ft. (*Godwin-Austen*).

Shell dextral, fusiform, thin texture; sculpture, close rather fine ribbing; colour pale ochraceous; spire conic, apex blunt; suture moderately impressed; whorls 7½, sides convex, swollen below; constriction in front, towards the outer margin of the peristome; aperture oval, vertical; columellar tooth fairly developed, blunt; peristome closely double, of weak structure.

Size: maj. diam. 2·4; alt. axis 3·8 millim.

This is larger than the other species from this peak and elevation; and is the species described as *D. sherfaiensis*, var., J. A. S. B. 1875, p. 9, pl. iv. fig. 5; but as it is sufficiently distinct from the form found on Sherfaisip Peak, far to the west, and also from another found on Shiroifurar Peak, I think it better to give it a distinctive title.

Diplommatina animula, n. sp.

Loc. Prowi, Lahupa Naga Hills, Munipur (*Godwin-Austen*).

Shell dextral, ovately fusiform, thin and delicate, and glassy texture; sculpture, rather distant well-marked costulation; colour whitish grey; spire moderately high, sides convex, apex blunt; suture impressed; whorls 6, tumid, sides very convex, antepenultimate

the largest; constriction in centre, above the aperture; aperture widely ovate, vertical, angulate on the lower margin of the columella; the tooth large and well developed; peristome very strong.

Size: maj. diam. 1·3; alt. axis 2·0 millim.

This is another minute shell, differing from all others I have seen in the strong peristome and large columellar tooth. *D. delicata* is its nearest ally.

Diplommatina subrubella, n. sp.

Loc. Japvo Peak (*Godwin-Austen*).

Shell dextral, small, fusiform; sculpture, fine, regular, rather close costulation; colour pale reddish; spire high, sides convex, apex blunt; suture impressed; whorls $6\frac{1}{2}$, sides convex, penultimate and antepenultimate equal; constriction in front, above the peristome; aperture circular, nearly vertical; columellar tooth very small and internal; peristome closely double, not thickened.

Size: maj. diam. 1·4; alt. axis 2·6 millim.

This is a close ally of *D. sherfaiensis*, but is much smaller and has a coarser sculpture.

Diplommatina subtilis, n. sp.

Loc. Margarita (*W. Doherty*, in coll. T. H. Aldrich).

Shell dextral, elongately ovate, thickened; sculpture, fine, close, regular costulation throughout; colour pale sienna-brown; spire with convex sides, apex blunt; suture impressed; whorls 6, sides convex, penultimate slightly the largest, the last does not rise much upon the penultimate; constriction in front, but not well marked; aperture circular, suboblique; columellar tooth well developed for the size of the shell; peristome double, strong.

Size: maj. diam. 1·0; alt. axis 1·5 millim.

This is a good species, one of the smallest; its elongated form separates it at once from *D. parvula*, the finer costulation and larger size from *D. minuta*.

Diplommatina delicata, n. sp.

Loc. E. Naga Hills? (*W. Doherty*, in coll. T. H. Aldrich).

Shell dextral, very small, tumidly fusiform; sculpture, very distant, strong costulation; colour pale horny; spire rather depressed, sides convex, apex blunt; suture well impressed; whorls 6, sides convex, swollen, antepenultimate the largest; constriction above the aperture; aperture ovate, vertical; columellar tooth well marked; peristome as usual.

Size: alt. axis 1·75 millim.

There are only two specimens in the collection among those merely labelled Naga Hills, but I have every reason to think they were from near Margarita.

Small species, with very minute or no columellar process or tooth.

These should eventually be brought into a subgenus of their own.

DIPLOMMATINA MUNIPURENSIS, n. sp.

Loc. South of the Barak River, between the Mao villages and Munipur (*Godwin-Austen*).

Shell dextral, elongately fusiform; sculpture minute, close costulation; colour very pale greenish grey; spire symmetrical, sides slightly convex; suture well impressed; whorls $6\frac{1}{2}$, sides convex; constriction in front and immediately above the aperture; no columellar tooth, its position indicated by a slight sinuosity on the columellar margin; aperture nearly circular, subvertical; peristome closely double, very slight in form, the inner does not spread much upward on the penultimate whorl.

Size: maj. diam. 1·5; alt. axis 2·7 millim.

From the number of specimens found, this appears a very abundant species; I never got anything like it in the Khasi Hills to the west.

DIPLOMMATINA VENUSTULA, n. sp.

Loc. Japvo Peak, Anghami Naga Hills (*Godwin-Austen*).

Shell dextral, elongately fusiform, thin; sculpture, fine, regular, close costulation throughout; colour pale amber; spire high, sides flattish, apex acuminate; suture impressed; whorls $7\frac{1}{2}$, sides convex, the penultimate the largest; constriction in front above the aperture; aperture widely ovate, suboblique; peristome but slightly developed, narrowly double, expanded into a small wing on the upper and outer margin, giving it a very sinuated margin; no columellar tooth.

Size: maj. diam. 2·1; alt. axis 4·0 millim.

This species, of which I only obtained 3 specimens, is quite distinct, as shown in the form of the spire and particularly the expanded side of the peristome, which is an unusual character.

DIPLOMMATINA DOMUNCULA, n. sp.

Loc. Margarita, Naga Hills (*W. Doherty*, in coll. T. H. Aldrich).

Shell dextral, fusiform; sculpture, strong, regular, distant costulation on all the whorls, much closer near the constriction, first two whorls smooth; colour pale whitish with an ochraceous tint; spire with convex sides, apex blunt; suture well impressed; whorls $7\frac{1}{2}$, sides convex, antepenultimate the largest, last whorl does not rise upon the penultimate; constriction above the aperture; aperture circular, subvertical, curvilinear as seen from the side; peristome double, not very much thickened; columellar tooth very minute, internal.

Size: maj. diam. 1·3; alt. axis 3·0 millim.

This is a very distinct form, quite new to me, and belonging to a group which is not represented, so far as I know, in the Khasi and Jaintia Hills.

Diplommatina succinea, n. sp.

Loc. Anghami Naga Hills (*Godwin-Austen*).

Shell dextral, tumidly fusiform, thin and delicate in texture; sculpture, regular, rather close costulation; colour very pale amber, with stronger coloration on the apex; spire somewhat depressed, suture impressed; whorls 6, tumid, with convex sides; constriction above the aperture; aperture oval, vertical; columellar tooth only indicated by a slight swelling; peristome double, strong.

Size: maj. diam. 1·3; alt. axis 2·0 millim.

This minute species may be compared with *D. parvula* from the N. Khasi Hills, from which it differs in being larger, and in having a greater number of whorls and a much more tumid shape.

Diplommatina concinna, n. sp.

Loc. Naga Hills, probably south of Margarita (*Doherty*, in coll. T. H. Aldrich).

Shell dextral, solid, fusiform; sculpture, very strong, rather distant costulation; spire tapering rapidly, apex acuminate; suture impressed; whorls 7, sides convex, penultimate and antepenultimate about equal in size; constriction hardly apparent, just above the aperture; aperture circular, vertical; columellar tooth quite minute, only an indication of it; peristome double, strongly developed.

Size: alt. axis 1·6 millim.

This is very distinct from any of the minute species I have hitherto examined from this part of India; it is distinguished by its thick shell and strong costulation.

Sinistral species.

Diplommatina gibberosa, n. sp.

Loc. South of the Barak River between Munipur and Imphal (*Godwin-Austen*).

Shell sinistral, ovately fusiform; sculpture, very distant fine costulation, 9 ribs on the antepenultimate whorl when viewed from the front; colour very pale greenish; spire low, sides rounded, apex blunt; suture very impressed; whorls $4\frac{1}{2}$, very swollen, sides very convex, penultimate much the largest; constriction on penultimate in centre above the aperture; aperture oval, subvertical; peristome double, strong; columellar tooth small, internal.

Size: maj. diam. 1·5; alt. axis 2·2 millim.

The nearest ally of this species is *D. jaintiaca*, G.-A., figured in the J. A. S. B. vol. xxxviii. pl. iii.; it differs, however, much in form, particularly in the expanded penultimate whorl and in its very distant sculpture. A very large number of it were collected in the above-named locality, and a single example at Prowi in the Lahupa Naga country.

In the collection sent me by Mr. Aldrich in a box marked Naga Hills were about 40 specimens of this shell. The exact locality

was not recorded, but I take it they were from some part of the Anghami Naga hills.

List of New Species and Varieties.

Constriction in front.
Sculptured throughout.
D. decorosa, p. 510.
Last whorls smooth.
D. garoensis, p. 511.
D. elongata, p. 511.
D. tumida, var., p. 512.
D. chennelli, p. 512.
D. butleri, p. 512.
D. ambigua, p. 513.
D. commutata, p. 513.

Constriction behind the peristome.
Sculptured throughout.
D. dohertyi, p. 513.
D. thomsoni, p. 514.
D. nengloensis, p. 514.
D. distincta, p. 514.
Last whorls smooth.
D. khunhoensis, p. 515.
D. lapillus, p. 515.
D. compacta, p. 515.

Small species, with columellar tooth.
D. unicrenata, p. 516.
D. japvoensis, p. 516.
D. animula, p. 516.
D. subrubella, p. 517.
D. subtilis, p. 517.
D. delicata, p. 517.

Small species, with very minute or no columellar process.
D. munipurensis, p. 518.
D. venustula, p. 518.
D. domuncula, p. 518.
D. succinea, p. 519.
D. concinna, p. 519.

Sinistral species.
D. gibberosa, p. 519.

6. On the Brain and Muscular Anatomy of *Aulacodus*. By Frank E. Beddard, M.A., F.Z.S., Prosector to the Society.

[Received May 3, 1892.]

The visceral anatomy of this Rodent has been described in the 'Proceedings' of this Society[1] by Mr. Garrod. The death of a specimen recently deposited in the Menagerie enables me to supplement that paper by a few notes upon the brain and the musculature which were not investigated by my predecessor.

I. Muscular Anatomy.

The *Pectoralis major* may be said to be composed of four more or less distinct portions; the attachments of these were at any rate separate: the first part of the complex muscle is inserted on to the deltoid ridge and is 16 mm. across at the insertion; immediately below this is a slip of the extensive *Panniculus carnosus*. Above this the second part of the pectoral is inserted on to the head of the humerus and for a certain distance down the shaft; the insertion is only slightly narrower than that of the first part, measuring 15 mm.; two smaller slips are inserted just below the second part

[1] "On the Visceral Anatomy of the Ground-Rat (*Aulacodus swinderianus*)," P. Z. S. 1873, pp. 786–789.

of the sterno-scapular; these may possibly be regarded as being collectively the equivalent of the *pectoralis minor* of other animals.

Both *Sterno-mastoid* and *Cleido-mastoid* are present; the latter is of about half the size of the former and arises from the middle of the clavicle.

The *Omohyoid* is present and is large.

The *Levator claviculæ* is continuous with part of the *panniculus carnosus*.

The *Latissimus dorsi* is a large muscle and gives off a good-sized *dorso-epitrochlear* slip to the elbow; the latter is 8 mm. across; the *latissimus dorsi* is inserted in common with the *teres*.

The *Trapezius* is extensive; it is continuous with part of the *panniculus*, but its strong tendon can be seen to be separate.

The *Rhomboideus* is attached along the whole length of the vertebral border of the scapula and also ventrally to the fascia covering the *supra-spinatus* and to the spine of the scapula itself, just at the point where the spine ends in the vertebral border of the scapula.

The *Sterno-scapular* is in two parts: the shorter and narrower part arises from the sternum and from the cartilage of the first rib; it is about 5 mm. across near to its origin; at the insertion it splits into two parts—one entirely muscular, the other nearly entirely tendinous; the former joins the fourth part of the *pectoralis*, the latter becomes continuous with the second and larger half of the *sterno-scapular*.

The *Deltoid* is a double muscle: one part arises from the clavicle, the other from the metacromion; they are inserted together above and to the outside of the insertion of the *pectoralis* to the deltoid ridge.

The *Biceps* is double-headed; the short head arises in common with the *coraco-brachialis*.

The *Coraco-brachialis* is a single muscle; its insertion extends 7 mm. beyond the insertion of the *teres*.

The *Brachialis anticus* has two heads of origin.

The *Triceps* is, as usual, a very massive muscle; the scapular head is the largest, and arises also partly from the fascia covering the *infra-spinatus*.

The *Teres major* ends in a flat tendon, 9 mm. across, which is, as has already been mentioned, inserted in common with the *latissimus dorsi*.

The *Subscapularis* commences about 12 mm. away from the vertebral border of the scapula.

The *Pronator radii teres* is inserted on to the middle of the shaft of the radius; the half nearest to the insertion has a glistening tendinous surface.

The *Flexor carpi radialis* arises from the flexor condyle of the humerus; its tendon begins 30 mm. from the origin.

The *Flexor carpi ulnaris* is a large muscle; the tendon, which is broad and strap-shaped, is the widest of all the flexor tendons.

The *Flexor sublimis* arises from the flexor condyle and from the septum between itself and the *flexor profundus*; it receives an excessively

delicate tendon (18 mm. long) from the ulnar head of the *flexor profundus*; it splits into three delicate nearly equi-sized tendons of insertion; of these the two outer are the thickest.

The *Flexor profundus digitorum* is composed of four parts: the largest arises from the flexor condyle; this gives off a branch about 15 mm. from its origin, which ends in a thin tendon apparently inserted into the palmar cartilage; the main muscle passes into a thick yellowish tendon which immediately joins that formed by the other divisions: the second head of the muscle arises from the middle of the shaft of the ulna; it becomes tendinous on the lower surface just before joining the others; there is also another smaller condylar head, which is soon joined by a head arising from the shaft of the radius; these divide into four tendons.

The *Extensores carpi radialis brevior and longior* are precisely as described by Messrs. Murie and Mivart in the Agouti; so, too, the *Extensor ossis metacarpi pollicis.*

There were no traces that I could discover of the *Extensor primi* or *secundi internodii pollicis.*

The *Pronator quadratus* is extensive, occupying nearly the whole of the shaft of the arm-bones.

The *Extensor carpi ulnaris* arises from the extensor condyle by a strong tendon on one surface and by a few fibres from the ulna; its strong tendon of insertion, which is 15 mm. long, is rounded.

The *Extensor indicis* is a small muscle; it arises from the middle of the ulna, and then becomes fused with the extensor mass.

The *Extensor minimi digiti* supplies digits IV. and V.

The *Extensor communis digitorum* divides early into three muscular bellies: two of these pass into tendons, which supply digits IV. and V. respectively; the tendon of the third splits into two, which go to digits II. and III.

The outside of the thigh is covered by a thick muscular mass, composed of several elements which are not to be very easily distinguished; a tendinous line separates the *Biceps* from the rest; the latter mass probably represents the *Tensor vaginæ femoris*, the *Glutæus maximus*, and the *Sartorius*. It is largely tendinous at its origin from the vertebral spines; the compound muscle is partly inserted on to the fascia covering the knee-joint; it is also inserted by a strong tendon on to the lower margin of the femur, just in front of the insertion of the *Glutæus medius*: I consider that this part of the compound muscle is undoubtedly the *Glutæus maximus.*

The *Biceps* is an enormous fleshy mass; it has the usual double origin and is inserted along the whole of the leg chiefly to the fascia covering the leg, but also in front by a short tendon to the patella.

The *Gracilis* is a double muscle; the two parts run side by side, arising from the symphysis pubis close together; they are also inserted close together on to the fascia covering the leg.

The *Semimembranosus* is composed of two distinct parts: the first part has a strong tendinous attachment to the inner condyle of the femur; the second part is a long thin muscle from the caudal vertebræ and is inserted just between the two heads of the

Gastrocnemius by a muscular insertion; it recalls the femoro-caudal of Birds.

The *Semitendinosus* arises by two heads; its flat strap-shaped tendinous insertion on to the tibia commences just after that of the *gracilis*.

The *Glutæus medius* is a powerful muscle hardly to be distinguished at its origin from the *Glutæus minimus*; it is inserted along the lower margin of the femur in front of the great trochanter for a distance of 30 mm.; the insertion is partly muscular and partly tendinous; the tendinous part of the insertion is divided up into a number of more or less distinct tendinous insertions.

The *Glutæus minimus* is a powerful muscle difficult to distinguish from the last at its origin; it arises from the greater part of the ilium; it becomes quite separate from the *Glutæus medius* a little before the insertion on to the great trochanter.

There was no trace that I could discover of a *Scansorius*, whose presence is mentioned in several Rodents.

The *Adductor magnus* is not by any means a large muscle; it is quite distinct from the other adductors; it is long and thinnish, and arises from the symphysis pubis by a tendinous origin; the upper surface of the muscle is glistening for a considerable distance after the origin.

The other two *Adductors* form a large fleshy mass and are not readily distinguishable from each other.

The *Iliacus* is a large muscle divided into two portions; it is inserted together with the *Psoas* on to the lesser trochanter.

The *Psoas magnus* is a large muscle, also divisible into two parts; the part which arises most anteriorly becomes tendinous on one side a couple of inches from its insertion.

The *Pyriformis* is present.

Both *Obturators* were present.

The *Rectus femoris* originates by two well-defined heads, which are tendinous, though overlaid by muscular fibres; the muscle is covered anteriorly by the *Vastus externus*.

The *Gastrocnemius* has the usual two heads, which take origin from two sesamoids; the inner head is the smaller of the two.

The *Plantaris* arises in common with the outer head of the last, and is fused with it for some way; it splits into three tendons on the sole of the foot.

The *Soleus* is fleshy with a tendinous origin from the head of the fibula; its exposed surface is glistening; it is inserted on to the os calcis.

The tendons of the *Flexores tibialis* and *fibularis* join before the latter splits into its four tendons of insertion: the tendon of the *Flexor tibialis* seems to be mainly concerned with the supply of the inner of the four tendons; the fourth of the four tendons of the *Flexor fibularis* is very much smaller than the rest, which is of course in relation to the comparatively rudimentary fifth toe; this tendon arises from the lower surface of the conjoined tendons and not from the outer edge.

The *Tibialis posticus* is covered by the *Flexor tibialis*; it becomes tendinous halfway down the leg.

The *Tibialis anticus* appears to be quite normal in size and attachments. So, too, the *Extensor digitorum longus* and the *Extensor hallucis* (which is inserted on to the second digit, the first being absent).

There are four *Peroneal* muscles; that supplying the fifth digit is very slender, both muscle and tendon, and is inserted on to the last phalanx.

The *Peroneus quarti digiti* is the outermost of the peroneal muscles; it is strong and has an insertion corresponding to the last muscle upon the fourth digit.

The *Peroneus brevis* is inserted on to the outermost metatarsal.

The *Peroneus longus* is the most superficial of the peroneals in origin; its tendon crosses the sole of the foot, as has often been described in Rodents.

The musculature of this Rodent is clearly more like that of the Hystricine genera than other forms; the arrangement of the long flexor tendons of the foot conform to the type met with in the Porcupines, Chinchillas, &c., and differs from the arrangement characterizing the Sciuromorpha and Myomorpha[1]. As *Aulacodus* is usually associated with *Capromys* it might be expected that the agreement in structure would be closer with that animal than with the Porcupines: I mention *Capromys* particularly since it is one of the few genera of the Octodontidæ of which the muscular anatomy has been described; its anatomy has lately formed the subject of an article in these 'Proceedings' by Dr. G. E. Dobson[2]. There is, in fact, a close similarity between the Rodent which forms the subject of the present communication and *Capromys*; the principal differences appear to be the following:—

(1) The *Deltoid* in *Capromys* arises partly from the spine of the scapula.

(2) The *Latissimus dorsi* has a double insertion, one part being connected with the *Pectoralis*.

(3) There is no tendon (?) connecting the *Flexor profundus digitorum* with the *Flexor sublimis*.

(4) The *Glutæus medius* is inserted by two thick tendons on to the great trochanter.

(5) The *Glutæus minimus* is "a narrow long muscle"; its insertion is between the two tendons of the last.

(6) The *Obturator internus* is absent.

(7) The *Semimembranosus* has only one part.

In some of these points where *Aulacodus* differs from *Capromys* it agrees with *Erethizon*[3]: the *Deltoid* is like that of *Erethizon*;

[1] "On the Homologies of the long Flexor Muscles, &c.," Journ. Anat. 1883, p. 142.

[2] "On the Myology and Visceral Anatomy of *Capromys melanurus*, with a Description of the Species," P. Z. S. 1884, p. 233.

[3] Mivart, "Notes on the Anatomy of *Erethizon dorsatus*," P. Z. S. 1882, p. 271.

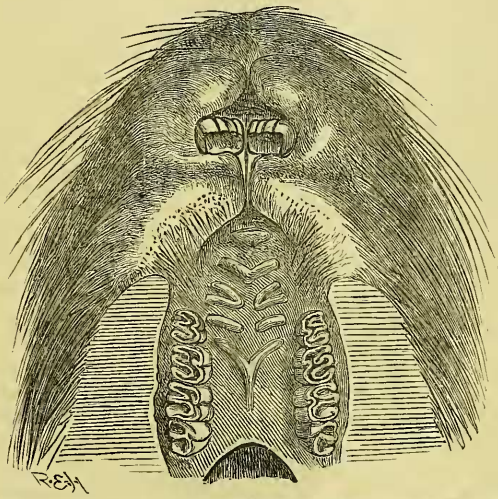
so, too, is the *Semi-membranosus* in having two distinct parts ; there is, however, too little known at present about the musculature of the Rodentia to allow of any detailed comparisons of *Aulacodus* with other types. I content myself therefore with pointing out the above-mentioned differences from its near ally *Capromys*.

II. Visceral Anatomy.

As I have already mentioned, Prof. Garrod has described the main points in the visceral anatomy of this Rodent ; I may, however, call attention to a few matters which he did not specially dwell upon.

The accompanying drawing (fig. 1) illustrates the *ridges* upon

Fig. 1.



Palate of *Aulacodus*, to illustrate the ridges upon the hard palate.

the *hard palate* ; these ridges, as will be seen from the figure, are symmetrical, and at the same time few in number ; they are for the most part in front of the molars. An inspection of the figure will save the necessity for any further description.

The *Spleen* is of a triangular form ; its longest diameter measures $2\frac{1}{4}$ inches, the shorter diameter $1\frac{3}{4}$ inches. The *Cæcum* has been very fully treated of by Garrod ; but he was in error, as I have already pointed out in a previous paper, in ascribing a unique character to the structure of this part of the alimentary canal ; in *Dolichotis* there are a series of folds in the interior of the cæcum which bear not a little resemblance to those of *Aulacodus*. Garrod has also said nothing about the folds of mesentery which support the cæcum ; near to the cæcum the small intestine has a mesentery

on both sides; about half an inch away from the intestine a fold arises from the mesentery supporting the intestine, which crosses over the intestine itself and is attached to the cæcum; a deep pocket is thus formed which is of course floored by the cæcum; on the opposite side there is a corresponding fold, arising, however, rather further away from the intestine; this also crosses the intestine and becomes fused with the fold running directly from the intestine to the cæcum. The cæcum is thus supported by three distinct folds, of which the median one, that arising from the intestine, is practically anangious; the two lateral folds which arise from the mesentery on the side furthest away from cæcum bear blood-vessels.

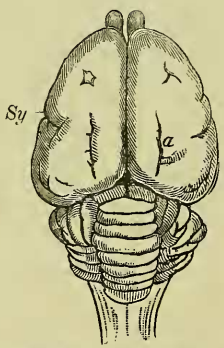
III. Brain.

The brain showed, after preservation in alcohol, the following proportions:—

Total length (to end of cerebellum) 37 mm.
Length of hemispheres 24 mm.
Greatest breadth 24 mm.
Vertical diameter 16 mm.

The outline of the brain as seen from above is shown in the accompanying drawing (woodcut, fig. 2). The two hemispheres

Fig. 2.



Brain of *Aulacodus*, viewed from above.
Sy, Sylvian fissure; *a*, longitudinal furrow.

are broader behind than in front; up to the Sylvian fissure the outer borders of the two hemispheres are approximately parallel to each other, though their outline is, of course, curved; from the Sylvian fissure to the anterior extremity of the brain these margins converge slightly, the diameter of the anterior extremity of the brain being 11 mm. The form of the hemispheres is in fact more like that of *Octodon* and *Myopotamus* among the immediate allies of *Aulacodus*: there is less similarity in the general shape of the

hemispheres to *Capromys*; this latter Rodent has the peculiar rounded hemispheres that characterize the Porcupines. As in most Rodents (and many of the lower Mammalia) the optic lobes are largely exposed; the degree to which the corpora quadrigemina are exposed in *Aulacodus* differs from that of any Rodent with which I have been able to compare its brain: the difference chiefly depends upon the form of the posterior margin of the hemispheres; these are very closely approximated in the middle line, and diverge posteriorly at a very wide angle; the posterior boundaries of the hemispheres, indeed, meet almost in the same straight line; there is no widening out of the median sulcus to form a triangular space, such as is evident, for example, in *Dolichotis patagonica*[1] and all other Rodents whose brains I have examined. As, however, the hemispheres do not come into contact with the cerebellum in the middle part above, there is a space left which is occupied by the two posterior lobes of the corpora quadrigemina. These two only are visible and they are raised almost to the level of the hemispheres themselves. As a rule, when the brain of a Rodent is viewed in profile, the corpora quadrigemina are seen upon the floor of a deep depression. Compare, for example, the accompanying drawing and fig. 4 A of my paper upon *Dolichotis* quoted below.

The cerebral hemispheres of *Aulacodus* are but faintly fissured.

The Sylvian fissure is, however, well marked, though short in extent; it runs on each side almost vertically upwards, its direction being, indeed, rather forwards at first and then curving backwards. Just in front of the Sylvian fissure at its origin is a short backwardly-directed furrow, which joins the Sylvian fissure, thus cutting off a small triangular piece of brain about 2 mm. in length; this perhaps represents the Island of Reil. The Sylvian fissure of *Aulacodus* is much better marked than it is in either *Myopotamus* or *Capromys*, in both of which the fissure is barely discernible.

The upper surface of the brain is but little marked by sulci; I have already pointed out that there is not an obvious relation between the size of the animal and the complexity of its brain-convolutions in the Rodentia. The Beaver with its nearly smooth brain is perhaps the most striking instance; and this example is additionally remarkable from the fact that aquatic mammalia seem, as a general rule, to have more richly convoluted brains than their purely terrestrial relations. The only fissure is the longitudinal fissure corresponding, I imagine, to that termed by Sir Richard Owen "lambdoidal"; the only fissures upon the brains of *Myopotamus* and *Capromys* were the same, which is so strongly developed in *Dolichotis*, *Cœlogenys*, and *Dasyprocta*. In *Aulacodus* this fissure does not run, as it does in *Dolichotis*, continuously from one end of the hemisphere to the other. There is a short fissure on each side, 7 mm. in length (*a*, in fig. 2); separated from this by a space of about 5 mm. is the anterior part of it, which is even less extensive.

[1] "Notes on the Anatomy of *Dolichotis patagonica*," P. Z. S. 1891, p. 236.